Comet Shoemaker-hwy 9: implications for Cometary Nucleus Structure and Density

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The tidal disruption and subsequent impact of fragments of comet Shoemaker-l evy 9 on Jupiter have provided important new clues as to the nature of cometary nuclei. The evidence strongly supports the primordial rubble pile and fractal models, which suggest that nuclei are weakly bonded, random assemblages of icy-conglomerate planetesimals. Such evidence includes the fading and dispersal of fragments, the secondary disruption of fragments, and the explosion of fragments relatively high in the Jovian atmosphere. The low tensile strength of cometary nuclei is confirmed. Modeling of the 1992 tidal disruption of S1 -9 by Asphaug and Benz (Nature 370, 120, 1994) sets a lower limit on the density of individual cometesimals of 0.4 g cm^{-3}. "l'he actual density may be considerably higher, on the order of 1.0- 1.3 g cm^{-3} depending on the rotation of the nucleus of S1 -9 prior to breakup, and on the true number of "original" fragments of the comet, immediately after breakup and reaccretion. Efforts to classify Shoemaker-1 evy 9 as an asteroid because of the failure to observe gas emission around the fragments are incorrect, as the expected gas production rates are less than the detectable limits. This work was supported by the NASA Planetary Geology and Geophysics Program,